# PART 5

# GENERAL PAINTING AND PROTECTION REQUIREMENTS

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## PART 5

## GENERAL PAINTING AND PROTECTION REQUIREMENTS

### 5.1 General

The preparation, application and conditions for work shall comply with the recommendations of BS 5493 and BS 6150 or if the protection is of a special nature, in accordance with the manufacturer's directions.

Paints, primers and undercoats shall be obtained from the same manufacturer and except where a definite time is specified between mixing and application, shall be ready mixed for use. They shall be compatible with one another.

Paints shall be delivered in sealed containers bearing the manufacturer's name, batch number, etc. and shall carry a label giving details of quality and instructions for use.

No site painting shall be carried out unless the surface to be painted is dry, the air temperature above 4°C and the relative humidity less than 85%.

Surfaces shall be prepared for painting in accordance with these specifications and the paint manufacturer’s written recommendations. Surfaces shall be clean of dirt, oil, grease or other deleterious substance. Painting shall not commence until surface preparation has been inspected and approved by the Engineer.

Test plates carrying finishes from the actual coating used may be required by the Engineer for inspection and test purposes.

To facilitate inspection, no consecutive coats of paint shall be of the same shade except in the case of white.

Priming to two mating surfaces shall be applied prior to assembly.

All items of Plant and equipment shall be delivered to Site with the shop paint finish applied unless specified otherwise. A further coat of final finish paint shall be applied at Site, of sufficient thickness to produce a uniform colour and appearance. Such painting shall be carried out within one month of successful acceptance trials for the Plant.

All paint thicknesses shall be checked using an alkometer or equivalent instrument, supplied by the Contractor, for each layer of paint, to the reasonable satisfaction of the Engineer.

## 5.2 Colour Coding and Labeling of Pipes and Equipment

All pipes and equipment shall be colour coded to a schedule to be agreed with the Engineer before any site painting starts, or earlier if necessary to suit manufacturing procedures. Contractor shall prepare the schedule at the appropriate time and submit to Engineer with reasonable time allowed for comment and approval. Valves and fittings shall be painted in the same colour as the pipe of which they form a part. Where a pipe enters or leaves a piece of equipment the pipe colour shall extend up to but not including the flange attached to the equipment.

All pipelines shall be identified by painted-on labels or stick-on 90 micron thick vinyl film labels showing the name of the material to be carried by the pipeline and an arrow indicating the direction of flow. Stick-on labels shall have an effective service life of not less than 10 years. In the case of stick-on labels, letters of titles shall be pre-spaced on carrier tape and the complete title protected by one piece removable liners. Titles shall be at intervals not less than 8 m, but shall in any case be provided in every space through which the pipe passes. Locations of labels shall be subject to prior approval by the Engineer. Lettering sizes shall be between 16 mm and 75 mm in height depending on the size of the pipe.

Pipes smaller than 22 mm outside diameter shall be labelled by the use of tags instead of labels. Tags shall be made of brass no smaller than 65 mm x 16 mm by 1.5 mm thick, with lettering etched and filled with black enamel.

Titles shall also be provided on all equipment in locations and in sizes to be approved by the Engineer.

## 5.3 Cleaning and Preparing at Place of Manufacture

The Contractor shall be responsible for the cleaning and preparation for painting, priming or otherwise protecting as specified of all parts of the Plant and equipment at the place of manufacture prior to packing.

### (a) Cleaning

Parts shall be cleaned prior to testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After

testing all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved dewatering fluid, prior to surface treatment.

**(b) Preparation**

Bright parts: Bright parts and bearing surfaces shall be thoroughly polished and protected from corrosion by the application of rust preventive lacquer or high melting-point grease, as approved by the Engineer, before the parts are packed. A sufficient quantity of the correct solvent for removal of the protective compounds shall be supplied and packed with each particular part.

Embedded parts: Embedded parts or those parts of an assembly which will be embedded in concrete shall be thoroughly descaled and cleaned to the satisfaction of the Engineer and before being packed shall be protected by a cement wash or other approved method. No cast iron or steel work shall be bitumen or tar coated where it is to be cast into the concrete and provision shall be made for cleaning off any portions so coated.

Grit or shot blasted parts: Grit or shot blasting shall be carried out in accordance with B.S. 7079 to a standard between `First Quality' and `Second Quality' given in Table 1 after which the maximum amplitude of the surface shall not exceed 0.1 mm.

Cast Iron and Steel pipework: All ungalvanised steel pipework including pump pipework, bearing spiders and tunnel tubes shall be prepared internally and externally by grit or shot blasting as specified above and the surfaces primed as specified within four hours of blasting.

## 5.4 Painting and Finishing at Place of Manufacture

This Clause governs the methods for the protective coatings to be applied to structural steel, metalwork and ironwork as corrosion protection systems. The systems designed as specified here shall be applied as specified under Protective Coatings. In case of conflict, protective coatings specified elsewhere for particular works such as pipes and cladding shall take precedence over any conflicting requirements specified herein. This specification makes reference to the following standard:

B.S.5493 "code of practice for the protective coating of iron and steel against corrosion"

The Contractor shall design each protective coating system and shall submit details of each system to the Engineer for approval. Submissions shall be in the

format of the examples given Clause 9.5 with such additional information and samples as the Engineer may require to enable the system to be assessed.

Protective coatings shall be designed in accordance with B.S. 5493 to have a long life, generally of at least 10 years to first maintenance. Protection systems shall be chosen to be easily maintained in the future and to allow non-specialist on-site re-coating where necessary using single part paints.

For the purposes of system design the general environment shall be as specified in B.S. 5493 Table 3 Part 2 `Exterior exposed polluted inland'. Bulkhead gates and stoplogs shall be assumed to be exposed to a Table 3 Part 8 `Non-saline water' environment unless otherwise approved by the Engineer.

Interior spaces shall be considered to be dry in administration areas open to continuous access and damp or immersed in other spaces. The protective coating of components or structures which are continuously or infrequently immersed shall be designed for the more onerous of these two conditions relevant to the protection system used.

All exterior exposed items to be coated shall have a final finish coat of aesthetically pleasing appearance of a colour and type as approved by the Engineer.

Protective coating systems shall generally fall into one of the following basic systems:

- galvanising;
- galvanising plus painting;
- multi-coat painting;
- bitumen enamel;
- others as proposed by the Contractor and approved by the Engineer.

The Contractor shall submit to the Engineer details of his proposals for the corrosion protection (generally falling into the above categories) of each of the items listed below and any other items requiring such protection:

- trash screens, flooring, ladders, access covers and frames, step irons and other components which are inaccessible but subject to abrasion/damage;
- structural steel work (including crane beams, monorails, crane structures and chassis), bulkhead gates, stop logs, grappling beams, steel tanks and other large items readily accessible for maintenance;

- valves and other corrosion-susceptible items which may be buried and are not covered by the provisions of other specifications :
- other components not covered by the above for which the contractor may propose a system which he considers to be more suitable for the duty;
- electrical switchgear, transformers, control panels etc.
- equipment, piping and miscellaneous metals.

All painting material shall be applied in strict accordance with the paint manufacturer's instructions.

(a) Plant supplied to site with final coating applied:
Cubicles, cabinets etc. other than those specified in Part 4 Section J

Before any steel work is painted the steel must be thoroughly cleaned and an approved anti-rusting priming coat applied so that the possibility of rusting or corrosion taking place is negligible. All surfaces should have not less than two stoved undercoats and two top coats or air drying paint. The undercoats shall be easily distinguishable in shade or colour form the priming and finishing coats. The two final coats shall be in a colour and finish to be advised by the Engineer. The inside surfaces of any cubicles, cabinets etc. where condensation is liable to occur, shall be coated with an approved anti-condensation composition. The Contractor shall ensure that all component sections of a switch board wherever manufactured shall have a finish of uniform texture and an exact colour match.

Chromium plated parts: Where chromium plating is specified or offered by the manufacturer it shall comply with the requirements of B.S. 1224 including the following provisions. No blistering of any surfaces will be tolerated. The finished appearance shall be bright. Where the base metal is steel, plating shall be applied in accordance with Table 2. Other base metals shall be plated in accordance with Tables 3, 4, 5 as appropriate. For all base metals the service condition number 2 shall be used.

Small bore pipes, valves and fittings etc., which are sited in architecturally finished areas and selected by the Engineer shall be chromium plated. Any damage to chromium plating shall be repaired before transfer of the facility to Owner.

Galvanised parts: All materials to be galvanised shall be of the full dimensions shown on the approved drawings or specifications and all welding, bending, punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanising process begins. Parts to be galvanised shall be

shot blasted as specified above. Such parts shall be galvanised not more than four hours after commencement of shot blasting. Any Site modification of galvanized parts shall be covered well by zinc rich primer and aluminium paint.

Wherever galvanizing has been specified the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

| | |
|---|---|
| Fabricated steel | |
| Thickness less than 2 mm but not less than 1.2 mm | 340 g/m$^2$ |
| Thickness 2 mm and above | 460 g/m$^2$ |
| Fasteners | |
| Up to nominal size M10 | 270 g/m$^2$ |
| Over M10 | 300 g/m$^2$ |

Galvanizing of material shall be carried out in accordance with the latest editions including all official amendments and revisions of IS 2629, 2633, 4759 and 6745.

All galvanising shall be done by the hot dip-process. No alternative process may be used without the approval of the Engineer. No components shall be galvanised which are likely to come into subsequent contact with oil.

The zinc coating shall be uniform, clean, smooth and free from spangle. In the case of component parts the zinc coating shall weigh not less that 610 g/m$^2$ of area covered and shall not be less than 0.090 mm in thickness.

Bolts and nuts shall be sherardised. The Engineer may select for test as many components to be weighed after pickling, and before and after galvanizing as he may think fit.

All galvanised parts shall be protected from injury to the zinc coating due to differential serration and abrasion during periods of transit, storage and erection. Damaged areas of the coating shall be touched up with an approved zinc-dust paint or other approved flake metallic compound.

Cast iron and steel pipework: (Internal surfaces)

The internal surfaces shall have an approved coating.

Where a bitumen based coating is used, it shall be in accordance with Type 2 of B.S. 4147.

Prior to lining, the pipe shall be grit blasted and primed with an approved primer. The lining shall be in accordance with B.S. 534. After installation, the internal lining shall be made good and satisfactorily tested with a Holiday detector to 8 KV.

The coating shall be suitable for use in contact with the respective process fluids. The type of coating shall be entered in Schedule L provided and the Engineer reserves the right to call for test plates of the paint. The manufacturer shall at the time of ordering carry out the `Taste and smell test' (Appendix E of B.S.4147) and `Effects on water test' (Appendix C of B.S. 3416) and forward 3 copies of the test results to the Engineer for approval.

Where pipes are to be welded after the protective coatings have been applied the pipe surfaces shall be primed and all other coating stopped 250 mm short of the weld preparation. Collars and fillings shall be primed but no other coating applied.

The manufacturer shall supply a sufficient quantity of suitable materials to repair damage occurring during delivery to site and to provide a flush finished internal lining at welded joints. Sufficient coating shall be supplied to fill in the recesses at internal welds over the previously primed areas. The costs of these materials shall be included in the unit rates for the supply of the pipes and specials.

The coating shall be applied in accordance with the manufacturer's instructions and with Appendices J and K of B.S. 3416.

Machinery- (Internal surfaces) e.g. pumps, valves, strainers, rising and suspension mains of wet well pumps:

As for cast iron and steel pipe work (Internal surfaces).

Cast iron and steel parts (External surfaces) immersed in Water:

All ungalvanised metal parts which will be immersed in water shall be cleaned by grit blasting and within four hours of blasting given a coating similar to that specified for internal surfaces.

Cast iron and steel (External surfaces) in manholes and areas of high humidity.

Ungalvanised metal parts exposed in manholes or areas of high humidity shall be cleaned by grit blasting and given two coats of a black bituminous solution.

(b) Plant forwarded to site for final finishing.

Cast iron and steel parts (External surfaces) outside buildings:

All ungalvanised metal parts which will be exposed to the outside atmosphere shall be cleaned by grit blasting and provided with two coats of an approved primer.

Cast iron and steel parts inside buildings:

All exposed metal surfaces which will not be immersed in water or exposed in areas described above shall be rubbed down, cleaned by grit blasting and within four hours of blasting given one coat of an approved primer before packing.

### 5.5 Painting at Site

Immediately on arrival at the site, all items of plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

Steel and cast iron parts received at site shall be provided with adequate number of further coats of coal tar epoxy polyamine coating to a total dry film thickness of 275 microns including the primer coats. All sharp edges, nuts, bolts and other items difficult to be painted shall receive a brush coat of specified paint before application of each coat of epoxy based coal tar paint giving a total dry film thickness of at least 275 microns. In the case of fabricated steelwork this work shall be done after assembly.

Before painting is commenced the Contractor shall submit for the approval of the Engineer, full details of the paints he proposes to use together with colour charts for the gloss finishes.

After erection, such items which are not finish painted shall be finish painted, items finish painted at the Manufacturer's works shall be touched up for any damaged paint work.

The painting work shall conform to the following requirements:

(a) The surface preparation shall be carried out generally in accordance with IS: 1477 Part I and IS: 6005
(b) After surface preparation, two coats of primer-red oxide zinc chromate with modified phenolic alkyd base conforming to IS: 2074 shall be applied. Dry film thickness of each coat shall be 25 microns.
(c) For finish painting, after application of primer as in (b) above, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be 25 microns.
d) Colours shall be selected as per IS: 5

No painting shall be carried out unless the item has been inspected and accepted by Engineers at the Manufacturer's works

The dry paint film thickness shall be measured by Electrometer or other instruments approved by the Employer. In order to obtain the dry film thickness DFT specified, the Contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 $kg/cm^2$. Painted fabricated steel Work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no poles of water or dirt can accumulate on the surface. Suitable packings shall be laid between the stacked Materials. Where cover is provided, it shall be ventilated.

The painting procedure shall be submitted in the following format:

(a) Surface Preparation
(b) Reference Standard
(c) Conditions of Work
(d) Type of Materials
(e) Tests and inspection methods and sequence, thickness (DFT)
(f) Colour in final coat
(g) Total thickness of coats (DFT)
(h) Other necessary data and information

The following items in the plant are required to be painted;

(a) Outer surfaces of pumps, valves, pipes, fittings, motors etc., not exposed to treated water
(b) Steelwork exposed to weather, such as outer surface of surge vessel, valves, pipes etc.

(c) Internal Plant and pipework, cranes, exhaust fans, fire extinguishers and miscellaneous steelwork not exposed to weather
(d) Steelwork exposed to weather, such as platforms, ladders, handrailing, etc.
(e) Steelwork exposed to humid weather and requiring hard maintenance and repairs
(f) Buried steelwork
(g) Buried pipes and fittings prior to application of wrapping
(h) Other equipment, as per requirement of employer.

All buried steel pipes and fittings shall be coated and wrapped with hot or cold applied, self-adhesive, polyethylene in accordance with AWWA C214 or equivalent Standard.

Cast iron or mild steel parts to be built into concrete shall remain unpainted. Immediately before it is cast in-situ, it shall be made perfectly free from dirt, scale, loose rust, paint, oil limewash or any other coating.

No blast cleaning or painting shall be applied to corrosion resistant Materials such as stainless steels, Ni-resist cast iron, bronze and other metals used for seals, bearings, lighting fitting etc.

Machined surfaces such as gear teeth shall be coated with a thick layer of grease. Other mechanical surfaces such as shaft ends or other bright parts shall be coated with two coats of an anti-rust solution which can be removed easily when required. Permanently bolted mechanical interfaces such as flanges shall be coated with a thin coat of anti-rust compound before assembly.

All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified.

Consecutive coats shall be in distinct but appropriate shades. All paints shall be supplied from the store to the painters, ready for application, and addition of thinners or any other Material shall be prohibited. Any instruction given by the paint manufacturer shall be strictly followed.

All painting shall be carried out by the painters under supervision. Paint shall be applied to the dry surface which has been prepared in compliance with the approved procedure.

Paint shall not be supplied or applied when the ambient temperature falls below 4$^{o}$C or relative humidity rises above 85%.

The Plant and equipment shall be inspected and reviewed at the various stages of the coating application both at the manufacturer’s Works and at the Site of the Works. Samples may be taken from the paints as delivered and submitted to such tests as are deemed necessary. The completed paint systems shall be tested by instruments to ensure that the protection is of adequate thickness and is free from pinholes and the direct measurement of adhesion shall be checked by the removal of a small section of the coating. The Contractor shall supply all instruments and apparatus required for carrying out such tests required by the Employer.

## 5.6 Waterworks Finish

A high standard of finish, defined as "Waterworks finish" is required for all Plant as detailed below.

### 5.6.1 Welding and flame cutting

A smooth neat finish, by careful grinding if necessary is required on all exterior welding and flame cutting. All plates and bars used in fabrication shall have smooth surfaces with no pitting or deep slag inclusions

### 5.6.2 Castings

Casting surfaces shall be smooth and free from surface blowholes. Stock castings shall be specially selected with this in mind.

All castings shall be shot blasted before machining.

### 5.6.3 Covers

All covers shall be firmly fixed. Weldmesh shall sit square in its frame. Where panels are placed next to each other the patterns shall line up.

### 5.6.4 Flanges and beadings

All bolt holes shall be spot faced parallel with the mating face for good seating of nuts and bolt heads. Surplus jointing shall be removed from mating faces and peripheries.

### 5.6.5 tems to be chromium plated

Name plates, instruction plates, rotation arrows, indicators and pointers, small bore pipework, tundish oil level gauges and fittings, small valves (including air valves), plugs and grease nipples, which are sited in architecturally finished areas and as selected by the Engineer, shall be chromium plated. Damage to chromium plating shall be made good.

All pipes, fittings and appurtenances, shall be fitted in a straight, neat symmetrical manner so as to present a pleasing appearance.

### 5.6.6 External screws, boltheads, nuts and washers

These shall be chromium plated, sherardised or shall be of stainless steel.

### 5.6.7 Gauges

All indicating gauges fitted to any machine assembly shall be of similar appearance and grouped together to present a pleasing aspect. They shall all have chromium plated cases, bezels, cocks and fittings.

**End of Part 5**